WS 11.3 Hess's Law Name:_____p._____

1. Given the following data:

$SO_{2\,(g)}$ -------> $S_{(s)} + O_{2\,(g)}$ $\Delta H = 296.8$ kJ

$2\ SO_{3\,(g)}$ ---------> $2\ S_{(s)} + 3\ O_{2\,(g)}$ $\Delta H = 791.4$ kJ

Use Hess's Law to calculate ΔH for this reaction: $2\ SO_{2\,(g)} + O_{2\,(g)}$ -------> $2\ SO_{3\,(g)}$

2. Given the following data:

$2\ P_{(s)} + 5\ Cl_{2\,(g)}$ -------> $2\ PCl_{5\,(s)}$ $\Delta H = -886$ kJ

$2\ P_{(s)} + 3\ Cl_{2\,(g)}$ -------> $2\ PCl_{3\,(l)}$ $\Delta H = -640.$ kJ

Use Hess's Law to calculate ΔH for this reaction: $PCl_{3\,(l)} + Cl_{2\,(g)}$ -------> $PCl_{5\,(s)}$

3. Given the following data:

$H_{2\,(g)} + F_{2\,(g)}$ -------> $2\ HF_{(g)}$ $\Delta H = -537.2$ kJ

$2\ H_{2\,(g)} + O_{2\,(g)}$ -------> $2\ H_2O_{(g)}$ $\Delta H = -483.6$ kJ

$H_2O_{(g)}$ -------> $H_2O_{(l)}$ $\Delta H = -44.0$ kJ

Use Hess's Law to calculate ΔH for this rxn: $2\ F_{2\,(g)} + 2\ H_2O_{(l)}$ -------> $4\ HF_{(g)} + O_{2\,(g)}$

4. Given the following data:

$CaCO_{3(s)} + 2\ HCl_{(aq)}$ -------> $CaCl_2(aq) + H_2O_{(l)} + CO_{2(g)}$ $\Delta H = -15.41$ kJ

$2\ CaO_{(s)} + 2\ H_{2(g)} + 2\ Cl_{2(g)}$ ------> $2\ CaCl_2(aq) + 2\ H_2O_{(g)}$ $\Delta H = -968.4$ kJ

$2\ HCl_{(aq)}$ -------> $H_{2(g)} + Cl_{2(g)}$ $\Delta H = 334.9$ kJ

$H_2O_{(l)}$ -------> $H_2O_{(g)}$ $\Delta H = 44.0$ kJ

Use Hess's Law to calculate ΔH for this rxn: $CaCO_{3(s)}$ -------> $CaO_{(s)} + CO_{2(g)}$

5. Olive oil contains many types of fat molecules. A typical molecular formula for olive oil is $C_{57}H_{104}O_6$, which has a molecular weight of 885.4 amu. When you metabolize ("burn") olive oil in your body, the following reaction occurs:

$$C_{57}H_{104}O_{6\,(l)} + 80\ O_{2\,(g)} \text{ ------> } 57\ CO_{2(g)} + 52\ H_2O_{(l)} \qquad \Delta Hrxn = -33429\ kJ$$

a. Calculate the energy (in kilojoules) produced when 1.00 gram of $C_{57}H_{104}O_6$ is metabolized.

b. Convert the answer in (b) to kilocalories (1 kcal = 4.184 kJ)

c. 1 gram of fat typically contains about 9 dietary calories. How does olive oil compare?

d. If 1.00 grams of $C_{57}H_{104}O_6$ react, how many grams of carbon dioxide gas would be produced (exhaled!)?

6. Ethanol (ethyl alcohol) has the formula $C_2H_5OH_{(l)}$.

a. Write a chemical equation for ethanol burning. Balance and include phase subscripts.

b. Without looking at any numbers, predict whether the above reaction will be exo- or endo-thermic, and explain your answer.

When 10.00 grams of ethanol are combusted under constant pressure conditions, the heat released is enough to increase the temperature of 2000. g of water from 10.0°C to 42.0°C.

c. Determine the heat energy absorbed/released (which is it?) by the water, in calories.

d. Convert your answer in (c) to kiloJoules.

e. Determine how many moles of ethanol burned in the experiment.

f. Determine ΔH_{rxn} for the combustion of ethanol in kJ/mole.

g. Write the heat term into the equation in (a).